

Fish Use Rates by California Tribes and Subsistence Fishing Communities

Fraser Shilling, PhD

Department of Environmental Science & Policy

University of California, Davis

fmshilling@ucdavis.edu

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Delta Watershed Fish Project
Fish Consumption Studies Group
Meeting Summary
May 18, 2004, Davis, CA

Background

⊕ Attendees:

NAME	AFFILIATION	EMAIL
Claus Suverkropp	LWA	clauss@lwa.com
Robert Nelson	Sac County DHHS	nelsonro@saccounty.net
Vicki Fry	SRCS	fryv@saccounty.net
Tu Bui	UC Davis/FSNEP	tdbui@ucdavis.edu
Sheri Zidenberg-Cherr	UC Davis/FSNEP	sazidenbergcherr@ucdavis.edu
Bob Brodberg	OEHHA	rbrodber@oehha.ca.gov
Donna Podger	CBDA	dpodger@calwater.ca.gov
Samira Jones	EHIB/DHS	Sjones1@dhs.ca.gov
Erica Weis	EHIB/DHS	eweis1@dhs.ca.gov
Alyce Ujihara	EHIB/DHS	aujihara@dhs.ca.gov
Fraser Shilling	UC Davis	fmshilling@ucdavis.edu

STATE WATER RESOURCES CONTROL BOARD
BOARD MEETING SESSION – DIVISION OF WATER QUALITY
SEPTEMBER 9, 2014

ITEM 8

SUBJECT

CALIFORNIA TRIBES FISH-USE STUDY

DISCUSSION

Tribes have expressed concern that water quality and other water-related decisions tend to lack consideration of tribes' use of water and aquatic resources. In 2012 - 2014, the State Water Resources Control Board (State Water Board) and the U.S. Environmental Protection Agency provided funding to UC Davis researchers to collaborate with tribes in discovering the historical and current patterns of fish use. UC Davis researchers worked with partner tribes to establish an appropriate approach to interviewing tribe members about fish use.

Members of 40 California tribes and tribe groups were surveyed directly at 24 locations, and staff from 10 tribes was surveyed online using standard questionnaires. Traditional uses of fish were assessed using literature review and surveying of tribe members and staff. Contemporary uses were assessed using tribe member interviews. UC Davis researchers found that tribes use fish in similar patterns (fish types and source-waters) as they did traditionally, but not in similar amounts. Tribes used 26 freshwater/anadromous fin-fish species, 23 marine fin-fish species, and 18 other invertebrate, and plant species and groups of species. The single most

- Subject of collaborative science and policy development for more than 12 years

Background (TMDL 2010)

- There have been previous study of fish consumption in the Bay Area (SFEI, 2001; 95th% = 32 g/day), Stockton (Silver et al., 2007, 95th% ~ 40-50 g/day), Delta region (Shilling et al., 2008, 95th% = 127 g/day)
- Consumption rates drive value of standard:



Contaminated fish consumption in California's Central Valley Delta[☆]

Fraser Shilling^{a,*}, Aubrey White^b, Lucas Lippert^a, Mark Lubell^a

^a Department of Environmental Science and Policy, University of California, One Shields Ave, Davis, CA 95616, USA
^b Department of Human and Community Development, University of California, Davis, CA 95616, USA

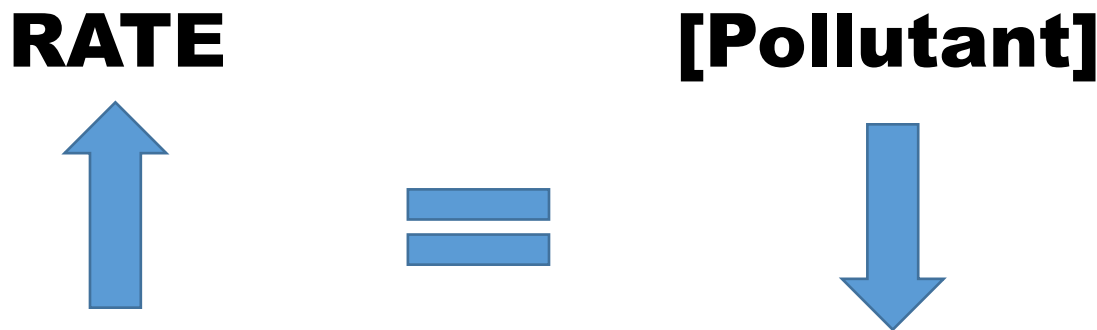
ARTICLE INFO	ABSTRACT
<p>Article history: Received 17 February 2009 Received in revised form 26 January 2010 Accepted 2 February 2010</p> <p>Keywords: Fish contamination Mercury Fish consumption Subsistence fishing TMDL Clean Water Act</p>	<p>Extensive mercury contamination and angler selection of the most contaminated fish species coincide in California's Central Valley. This has led to a policy conundrum: how to balance the economic and cultural impact of advising subsistence anglers to eat less fish with the economic cost of reducing the mercury concentrations in fish? State agencies with regulatory and other jurisdictional authority lack sufficient data and have no consistent approach to this problem. The present study focused on a critical and contentious region in California's Central Valley (the Sacramento–San Joaquin Rivers Delta) where mercury concentrations in fish and subsistence fishing rates are both high. Anglers and community members were surveyed for their fish preferences, rates of consumption, the ways that they receive health information, and basic demographic information. The rates of fish consumption for certain ethnicities were higher than the rates used by state agencies for planning pollution remediation. A broad range of ethnic groups were involved in catching and eating fish. The majority of anglers reported catching fish in order to feed to their families, including children and women of child-bearing age. There were varied preferences for receiving health information and no correlation between knowledge of fish contamination and rates of consumption. Calculated rates of mercury intake by subsistence anglers were well above the EPA reference dose. The findings here support a comprehensive policy strategy of involvement of the diverse communities in decision-making about education and clean-up and an official recognition of subsistence fishers in the region.</p> <p>© 2010 Published by Elsevier Inc.</p>

1. Introduction

The present study provides critical data to support decision-making to reduce fish contamination, involve diverse stakeholder communities, and encourage safer fishing and eating patterns in California's Delta. The US Department of the Interior estimates that 10% of Californians engage in sport and subsistence fishing (USDI et al., 2003), many of whom fish in the watersheds of the Sacramento–San Joaquin Rivers Delta and San Francisco Bay. Subsistence fishing in areas with fish contamination creates the need for immediate policy initiatives, both to educate anglers about

contamination and to speed the rate of remediation of the contamination. In California, fish contamination from mercury, polychlorinated biphenyls (PCBs), and other chemicals threatens fish consumption as a part of the daily diet. There has never been an economic evaluation of the cost of reducing fish contamination in California, though it is popularly thought to be high. Because of this perceived high cost of remediation, public agencies in California have proposed reducing fish consumption to reduce risk and exposure. There are actually several policy strategies that are available: (1) clean up environmental contamination in accordance with the Clean Water Act and California's Porter-Cologne Act, (2) educate subsistence anglers about fish contamination, allowing them some choice, and (3) the combination of (1) and (2), developing pollution remediation plans that comprehensively deal with clean-up, new discharges, angler education, and inclusion of impacted communities. Currently, there is insufficient knowledge of fish consumption practices in California's Delta to make an informed choice among policy options.

California's growth was based initially on a gold-mining boom. Mercury mined in the Coast Ranges was used in the Coast and interior ranges to improve gold recovery (Agners and Humerlach, 2000). The watersheds of the Central Valley contain thousands of legacy mercury and gold mining features. Mercury also originates from natural geothermal activity, soil, atmospheric deposition,

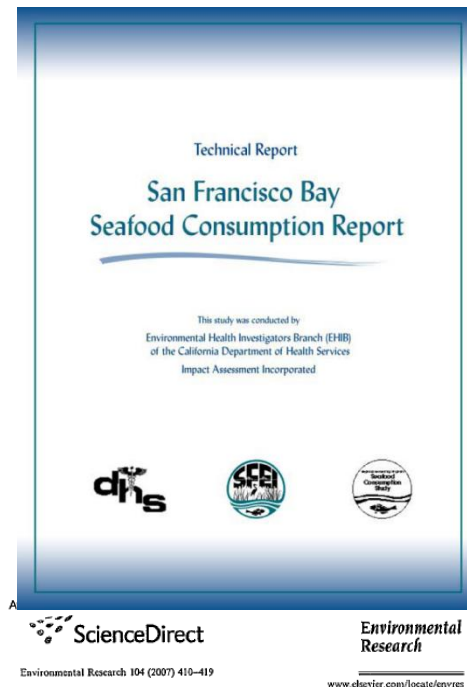


Abbreviations: ANOVA, analysis of variance; CDFG, California Department of Fish and Game; CWRWQCB, Central Valley Regional Water Quality Control Board; FFO, Food Frequency Questionnaire; PCBs, polychlorinated biphenyls; SAC, Southeast Asian Assistance Center; SFB, San Francisco Bay Area Institute; TMDL, total maximum daily load; USDA, US Department of Agriculture; USEPA, US Environmental Protection Agency.

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* Corresponding author. Fax: +1 530 752 3150.
E-mail addresses: fshilling@ucdavis.edu (F. Shilling), aubreywhite@gmail.com (A. White), llippert@ucdavis.edu (L. Lippert), mlubell@ucdavis.edu (M. Lubell).

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Fish consumption and advisory awareness among low-income women in California's Sacramento–San Joaquin Delta[☆]

Elana Silver^a, Jessica Kaslow^a, Diana Lee^b, Sun Lee^a,
May Lynn Tan^a, Erica Weis^b, Alyce Ujihara^{b,*}

^a Impact Assessment Inc., California Department of Health Services, Environmental Health Investigators Branch,
850 Marina Bay Parkway, Building P, Third Floor, Richmond, CA 94804-6403, US

^b California Department of Health Services, Environmental Health Investigators Branch, 850 Marina Bay Parkway,
Building P, Third Floor, Richmond, CA 94804-6403, US

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Abstract

Fishing is a culturally important activity to the ethnically diverse population living in California's Sacramento–San Joaquin Delta. Due to runoff from abandoned gold mines, certain Delta fish are contaminated with methylmercury, a neurodevelopmental toxin. A state health advisory recommends limited consumption of certain Delta fish, to be followed in conjunction with a federal advisory for commercial and sport fish. We conducted a survey of low-income women at a Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) clinic, to characterize commercial and sport fish consumption patterns and advisory awareness. Ninety-five percent of women consumed commercial fish. Thirty-two percent consumed sport fish; this proportion was much higher in Hmong (86%) and Cambodian, (75%) women. Ninety-nine percent of sport fish consumers also consumed commercial fish. The overall fish consumption rate among consumers was 27.9 g/day (geometric mean, past 30 days, cooked portion); commercial and sport fish consumption rates were 26.3 and 10.3 g/day, respectively. We found ethnic differences in overall fish consumption rates, which were highest in African Americans (41.2 g/day) and Asians (33.6 g/day), particularly Vietnamese and Cambodians. Pregnant women ate less fish overall than other women (16.8 vs. 30.0 g/day, $p = 0.0001$), as did women who demonstrated specific advisory awareness (23.3 vs. 30.3 g/day, $p = 0.02$). Twenty-nine percent of all women exceeded federal fish consumption advisory limits. These results highlight the need for culturally and linguistically appropriate interventions that address both commercial and sport fish consumption.
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Keywords: Fish; Advisory; Methylmercury; Women; California

1. Introduction

The health benefits of consuming fish are well documented. Fish are a source of omega-3 fatty acids and can protect against cardiovascular disease (Kris-Etherton et al., 2002; Mozaffarian and Rimm, 2006), improve cognitive development in children (Daniels et al., 2004), and slow

cognitive decline in the elderly (Morris et al., 2005). However, methylmercury and other chemical contaminants found in some fish can counteract these benefits. Methylmercury can impair neurological development; high levels are toxic to children and adults (NAS, 2000). Even at low levels of exposure, methylmercury from maternal fish consumption has been associated with subtle neurotoxicity in children (NAS, 2000). Nationwide, it is estimated that six percent of women of childbearing age have blood methylmercury levels of potential health concern (MMWR, 2004). Fish consumption is believed to be the primary source of exposure to methylmercury.

[☆] This study was funded by the Ecosystem Restoration Program of the California Bay-Delta Authority. Since the survey described in this manuscript was conducted anonymously, and no identifying information was collected from subjects, IRB approval was not required according to

Approach

- Standard method developed in early 2000s among collaborating organizations (CDHS, UCD, OEHHA, RB, et al.). Used most recently in SD in 2015-2016
- How are tribes and communities using fish? How does use vary regionally and among tribes or communities? How does current use compare to traditional/historical use? What will this mean for state policies?
 - Interview people about contemporary/current fish use and traditional fish use using standard instrument
 - Contact and interview members of as many tribes and communities as possible
 - Do this in partnership with tribes and communities

Standard subsistence fish consumption rates from Delta study (Shilling et al., 2010)

MEAN Rates of local (total) fish consumption for Delta anglers (N = 513, field component)

All Southeast Asian	(N=286)	41 (50) g/day
Lao	(N = 54)	47 (54) g/day
African-American	(N = 32)	31 (48) g/day
Women child-bearing age	(N = 217)	38 (54) g/day

MOST-SENSITIVE Rates of local (total) fish consumption for Delta anglers (95th%)

African-American	242 (252) g/day
All Southeast Asian	129 (180) g/day
Lao	310 (318) g/day
Women child-bearing age	227 (263) g/day

How much mercury is consumed from Delta study,
compared to EPA standard (7 micro-grams/day)?

MEAN Rates of local (total) mercury intake for Delta anglers (N = 513)

All Southeast Asian	(N=286)	14 (17) ug/day
Lao	(N = 54)	27 (29) ug/day
African-American	(N = 32)	16 (21) ug/day
Women child-bearing age	(N = 217)	16 (21) ug/day

MOST-SENSITIVE Rates of local (total) mercury intake for Delta anglers (95th%)

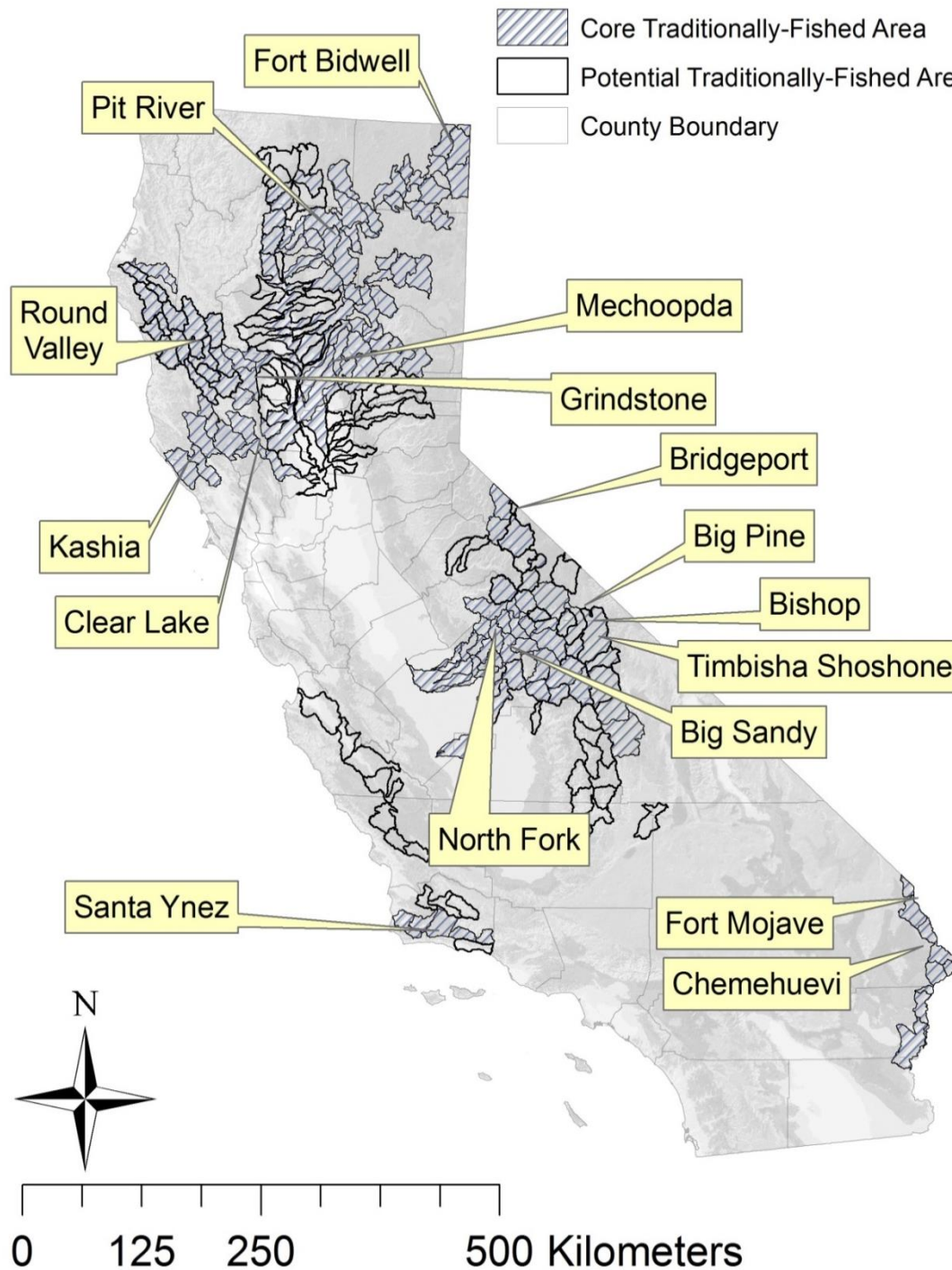
African-American	128 (131) ug/day
All Southeast Asian	63 (75) ug/day
Lao	161 (164) ug/day
Women child-bearing age	95 (105) g/day

Findings for Tribes (2013-2014)



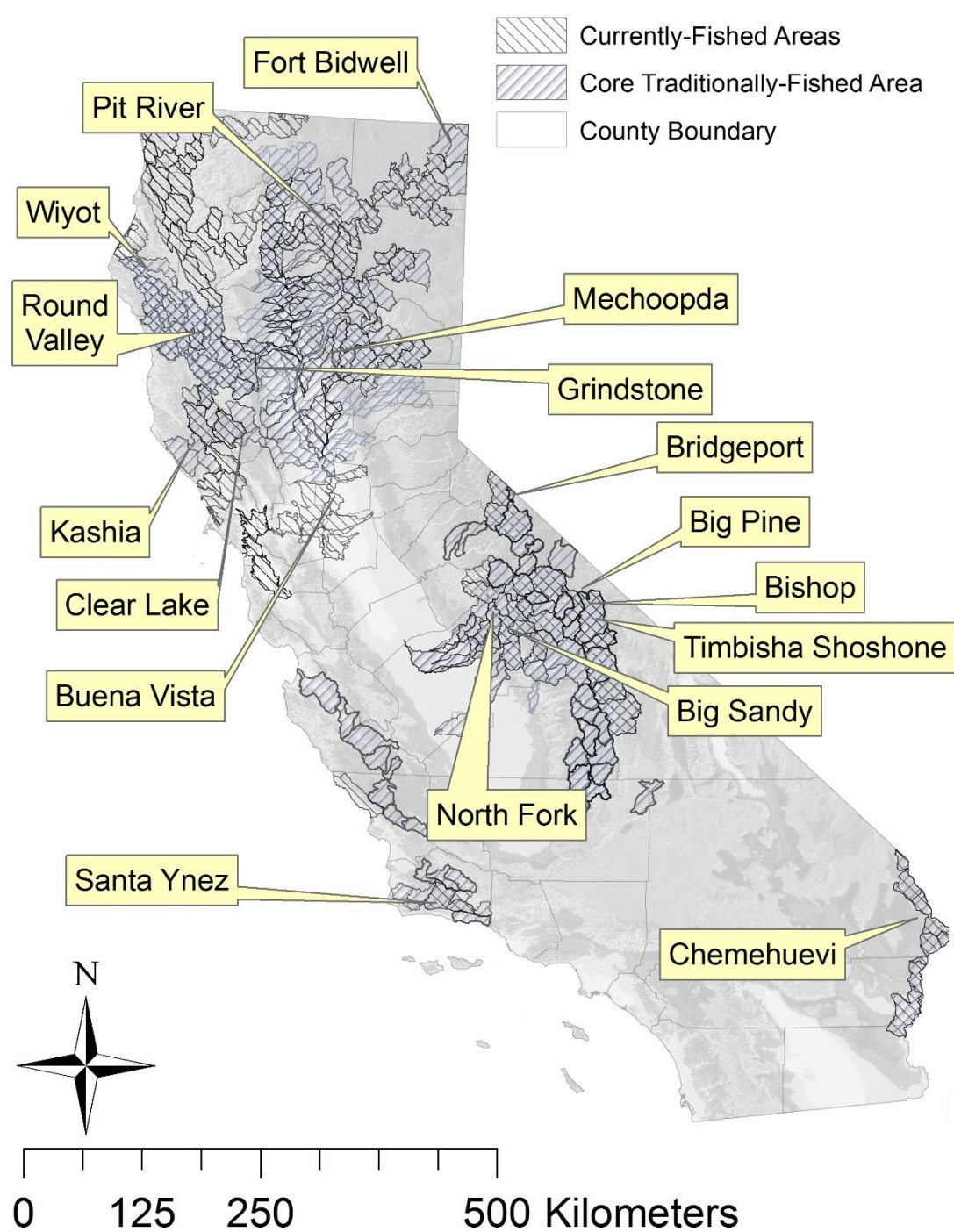
Maintenance of traditional fish use (Sample of tribes)

Tribe/Location	Aquatic species /species groups	Similarity (%)
Me-Wuk (37)	Salmon, trout, sturgeon, catfish, striped bass, bivalves, lobster/crab, crayfish, halibut, abalone, carp, sunfish/bluegill, perch, largemouth bass, snapper, cod, rockfish, lamprey/ eel, crappie, smelt, shrimp, squid, steelhead, American shad	100
Nomlacki (31)	Catfish, salmon, trout, abalone, lobster/crab, seaweed, bivalves, striped bass, largemouth bass, shrimp, sunfish/bluegill, carp, surf-fish, perch, sturgeon, kelp, Sacramento pikeminnow, lamprey/ eel, shark, sucker, crappie, hitch, steelhead, halibut, squid	80
Mono (6)	Salmon, trout, striped bass, largemouth bass, catfish, bivalves, smallmouth bass, sunfish/bluegill, sucker, lobster/crab, watercress	47
Maidu (32)	Salmon, trout, catfish, lobster/crab, largemouth bass, striped bass, crayfish, abalone, shrimp, bivalves, seaweed, sunfish/bluegill, sturgeon, carp, halibut, cod, tuna, perch, lamprey/ eel, rockfish, Sacramento pikeminnow, crappie, surf-fish, smallmouth bass, hitch, snapper, lingcod, tilapia, seabass, shark	47
Paiute (Bishop, 17)	Trout, salmon, catfish, crayfish, bivalves, largemouth bass, water cress, sunfish/bluegill, lobster/crab, brine fly larvae, carp, tule, striped bass, codfish, abalone, tuna, rockfish, perch, frog, sturgeon, lingcod, tilapia, haddock, algae, cattails	50
Paiute (Big Pine, 24)	Salmon, trout, crayfish, catfish, lobster/crab, bivalves, shrimp, largemouth bass, carp, sunfish/bluegill, striped bass, triggerfish, swordfish, mahi mahi,	29
Paiute (Bridgeport, 18)	Salmon, trout, catfish, crayfish, striped bass, largemouth bass, sunfish/bluegill, cui cui, tui chub, bivalves, sturgeon, smallmouth bass, perch, carp, pupfish, mountain whitefish, sucker, lobster/crab, abalone	57
Northern Paiute (Fort Bidwell, 11)	Salmon, trout, catfish, crayfish, lobster/crab, bivalves, abalone, largemouth bass, sturgeon, shrimp, cutthroat trout, striped bass, walleye, snapper, squid, scallop	36
Timbisha Shoshone (14)	Trout, catfish, salmon, crayfish, largemouth bass, lobster/crab, bivalves, sunfish/bluegill, striped bass, carp, watercress, shrimp, tuna, halibut, squid, shark, perch, crappie, rooster fish, cod, abalone, brine shrimp larvae, snail	80
Washoe (6)	Salmon, trout, catfish, smelt, abalone, striped bass, largemouth bass, smallmouth bass, perch, sunfish/bluegill, sturgeon, steelhead, bivalves, crayfish	100
Chemehuevi (46)	Striped bass, catfish, largemouth bass, salmon, trout, sunfish/bluegill, crayfish, bivalves, lobster/crab, carp, abalone, tuna, smallmouth bass, sturgeon, shark, swordfish, tilapia, perch, halibut, sea bass, cod, orange roughy, squid, seaweed	60
Mojave (5)	Catfish, trout, striped bass, largemouth bass, salmon, crayfish, smallmouth bass, sunfish/bluegill, sturgeon, carp, steelhead, tuna, tilapia, bivalves, lobster/crab	64
Pit River (27)	Salmon, trout, catfish, bivalves, lobster/crab, sturgeon, largemouth bass, crayfish, abalone, striped bass, squid, seaweed, sunfish/bluegill, sucker, lamprey/ eel, smallmouth bass, shrimp, carp, tule, watercress, perch, cabezon, cod, split-tail, Sacramento pike minnow, halibut, lingcod, snapper, tuna, surf-fish, rockfish	88
Wiyot (32)	Salmon, lobster/crab, trout, bivalves, sturgeon, lamprey/eel, abalone, surf perch, smelt, cod, catfish, rockfish, largemouth bass, halibut, sunfish/bluegill, steelhead, striped bass, night fish, perch, cabezon, snapper, crayfish, carp, tuna, sand dabs,	100
Hoopa (Blue Lake/Bear River 4)	Salmon, sturgeon, trout, steelhead, lamprey/eel, lobster/crab, bivalves, abalone, crayfish	ND
Karuk (Bear River, 3)	Salmon, sturgeon, trout, lamprey/eel, snapper, ling-cod, halibut, lobster/crab, bivalves, abalone, crayfish, seaweed, catfish, striped bass, largemouth bass, perch, steelhead, smelt, rockfish, surf fish, cod, tuna, flounder, ray, squid, snail	ND
Pomo (Clear Lake, 164)	Salmon, catfish, trout, abalone, lobster/crab, bivalves, largemouth bass, hitch, crayfish, striped bass, carp, seaweed, sturgeon, perch, surf-fish, smelt, crappie, lamprey/eel, halibut, shrimp, squid, tilapia, tuna, snapper, kelp, snail, blackfish, sea slug, rockfish, American shad	63
Pomo (Kashia, 23)	Salmon, abalone, bivalves, trout, seaweed, lobster/crab, striped bass, largemouth bass, surf-fish, crayfish, sunfish/bluegill, catfish, bullhead, snail, tilapia, carp, sturgeon, split tail, perch, cabezon, kelp, rock cod, rock fish	63
Pomo-Wailaki (12)	Split-tail, carp, lobster/crab, seaweed, striped bass, salmon, kelp, largemouth bass, smallmouth bass, trout, Sacramento pike minnow, abalone, cod, catfish, sunfish/bluegill, blackfish, bivalves, crayfish, smelt, sea anemone	69
Wailaki (16)	Salmon, trout, catfish, abalone, lobster/crab, striped bass, smelt, carp, crayfish, largemouth bass, split-tail, sturgeon, bivalves, seaweed, sunfish/bluegill, steelhead, cabezon, cod, halibut, shrimp, kelp	83
Round Valley (35)	Salmon, trout, abalone, smelt, striped bass, catfish, lobster/crab, steelhead, sturgeon, bivalves, crayfish, largemouth bass, sunfish/bluegill, lamprey/eel, cod, snapper, carp, seaweed, tuna, hitch, nightfish, rockfish, surf-fish, crappie, halibut, squid	ND
Yurok (15)	Salmon, sturgeon, trout, lobster/crab, cod, steelhead, lamprey/eel, bivalves, surf-fish, abalone, halibut, striped bass, largemouth bass, catfish, sunfish/bluegill, rockfish, crayfish, perch, carp, smelt, tuna, crappie, Sacramento pike minnow, nightfish, walleye, snapper, seaweed	ND
Chumash (12)	Trout, salmon, catfish, crayfish, largemouth bass, lobster/crab, halibut, bivalves, sunfish/bluegill, sturgeon, striped bass, abalone, shrimp, snapper, perch, carp, smelt, rockfish, cabezon, tuna, flounder, lingcod, snail	71



Very important – this map represents the fished areas by interviewed tribes, as shown, and should not be used to delimit ALL tribe fish use. Other tribes that were not interviewed are likely to fish in their own regions. The areas shown represent use by 16 of the 146 tribes in CA. If all tribes were interviewed, it is likely that the vast majority of CA waterways would be considered traditionally and/or currently fished.

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Species	WBRegion				Total
	CentCoast	CentVal..	Lahontan	North C..	
Bass	11.11	7.76	3.08	7.94	6.37
Black crappie	0.00	3.05	0.51	0.00	1.91
Blackfish	0.00	0.28	0.00	0.00	0.16
Bluegill	0.00	6.65	4.62	1.59	5.41
Brook trout	0.00	0.28	3.08	0.00	1.11
Brown trout	0.00	0.55	10.26	0.00	3.50
Bullhead	0.00	0.28	0.00	6.35	0.80
Carp	0.00	5.26	6.15	1.59	5.10
Catfish	11.11	16.07	15.90	9.52	15.29
Chi/Hitch	0.00	8.03	0.00	6.35	5.25
Chub	0.00	0.00	4.10	0.00	1.27
Cutthroat trout	0.00	0.00	4.10	0.00	1.27
Golden trout	0.00	0.00	3.08	0.00	0.96
Lahontan Dace	0.00	0.00	0.51	0.00	0.16
Largemouth Bass	0.00	0.55	2.56	0.00	1.11
Minnow	0.00	0.28	0.51	0.00	0.32
Native trout	0.00	0.55	0.00	0.00	0.32
Perch	0.00	9.14	0.51	3.17	5.73
Pike	0.00	1.94	0.00	0.00	1.11
Pupfish	0.00	0.00	5.13	0.00	1.59
Quiee	0.00	0.00	0.51	0.00	0.16
Rainbow Trout	0.00	1.66	11.79	0.00	4.62
Salmon	33.33	12.74	4.10	31.75	12.26
Shad	0.00	0.28	0.00	0.00	0.16
Shapal	0.00	0.28	0.00	0.00	0.16
Smallmouth Bass	0.00	0.00	1.03	0.00	0.32
Speckled dace	0.00	0.00	1.54	0.00	0.48
SP Minnow	0.00	0.28	2.05	0.00	0.80
Steelhead	11.11	4.16	0.51	12.70	3.98
Sturgeon	0.00	2.22	0.51	3.17	1.75
Sucker fish	0.00	6.65	4.10	0.00	5.10
Trout	33.33	11.08	9.74	15.87	11.46
Total	100.00	100.00	100.00	100.00	100.00

Contemporary Freshwater Fish Use

- Use of most species varies considerably among tribes (>2-fold)
- Bass use varies between 6.7% (Lahontan) and 11.1% (C Coast) of FW fish
- There is no “index fish” across all tribes

Contemporary rates of fish consumption for all interviewed tribe members.

Component	Min (g/day)	Max (g/day)	95 th % (g/day)	99 th % (g/day)
Salmon	0	382.7	72.6	179.9
All caught fish	0	623.7	141.8	240.2
Bought fish	0	255.1	60.8	152.1
Other aquatic organisms	0	402.6	27.7	96.8
Total fish	0	623.7	181.9	333.2
Total aquatic organisms	0	708.7	200.0	399.5

NB – the rates of contemporary consumption rates are significantly lower than the estimated traditional rates (frequency times portion size), $P < 0.001$

What Does This All Mean?

- California tribes are currently consuming up to 1 meal of fish every day or two
- Traditional fish use and consumption rates are being threatened by lack of water, contamination, and overfishing
- Tribe members consume at least 5 times as much as the state agencies have assumed (32 g/day)
- Fish tissue standard based on 142 g/day is minimum action

Opinion: Results suggest that to protect tribe fish use, state regulations should:

- Assume that tribe fish use has been suppressed relative to historical, so recoverable rates and patterns should be used = historical rates and patterns
- Assume tribe fish use occurs in all state waters, unless cross-seasonal surveying determines that it does not
- Use water quality and flow protection authority to protect fish populations, which protects fish beneficial use
- Assume that fish species used and the amounts used vary among tribes, but that 142-182 g/day reflects 95% of consumption of a mixture of fish (Shilling et al., 2014)

Opinion: Results suggest that to protect subsistence fish use, state regulations should:

- Assume that subsistence fish use occurs near many urban centers and rural towns
- Assume subsistence fish use occurs in all state waters near populated center, unless cross-seasonal surveying determines that it does not
- Use water quality and flow protection authority to protect fish populations, which protects fish beneficial use
- Use standard rate found in Delta of 127-147 g/day (local & total, Shilling et al., 2010) to develop a subsistence fish tissue objective

Questions?



Fraser Shilling, UC Davis
fmshilling@ucdavis.edu